

CLAIMS:

1. A tire-state obtaining apparatus including a plurality of wheel-side devices respectively provided on a plurality of wheels of a vehicle, and a body-side device disposed on a body of the vehicle, said tire-state obtaining apparatus obtaining states of tires of the wheels on the basis of information transmitted from said wheel-side devices, characterized in that:

each of said plurality of wheel-side devices includes (a) a tire-state detecting device operable to detect the state of the tire of the corresponding wheel, and (b) a transmitter device operable to transmit a series of tire information including tire-state data indicative of the state of the tire detected by said tire-state detecting device; and

said body-side device includes (c) at least one receiver device each provided commonly for at least two of the transmitter devices of said plurality of wheel-side devices and operable to receive sets of the tire information transmitted from said at least two transmitter devices, and (d) a wheel-position-related-data obtaining device operable to obtain wheel-position-related data relating to positions of said wheels, on the basis of conditions in which said at least one receiver device receives the sets of tire information transmitted from said transmitter devices.

2. A tire-state obtaining apparatus according to claim 1, wherein said tire information includes identification data identifying the wheel corresponding to the transmitter device from which said tire information has been transmitted, and said wheel-position-related-data obtaining device includes a wheel-position-related data memory portion for storing said identification data included in said tire information and said wheel-position-related data relating to the position of the wheel corresponding to said transmitter device from which said tire information has been transmitted, such that said identification data and said wheel-position-related data are correlated with each other.

3. A tire-state obtaining apparatus according to claim 1 or 2, wherein said wheel-position-related-data obtaining device obtains said wheel-position-related data on the basis of the conditions in which said at least one receiver device receives the sets of tire information and rotating states of said wheels.

4. A tire-state obtaining apparatus according to any one of claims 1-3, wherein said transmitter device transmits said tire information for a length of time required for at least one full rotation of the corresponding wheel, and said wheel-position-related-data obtaining device obtains said wheel-position-related data on the basis of the condition in which said at least one receiver device receives said tire information transmitted from said transmitter device for said length of time.

5. A tire-state obtaining apparatus according to any one of claims 1-4, wherein each of said at least one receiver device includes at least one receiver antenna, and said body-side device further includes an antenna-moving device operable to move at least one of said at least one receiver antenna.

6. A tire-state obtaining apparatus according to any one of claims 1-5, wherein each of said at least one receiver device includes one receiver antenna, and said body-side device further includes an antenna-moving device operable to move said one receiver antenna.

7. A tire-state obtaining apparatus according to claim 5 or 6, wherein said antenna-orientation adjusting device includes a relative-position changing device operable to change a relative position between said receiver antenna and each of said at least two of said transmitter devices, and a changing-device control portion operable to control said relative-position changing device.

8. A tire-state obtaining apparatus according to any one of claims 5-7, wherein said antenna-moving device includes a moving-state changing portion operable to change a state of

movement of said receiver antenna, on the basis of rotating states of the wheels.

5 9. A tire-state obtaining apparatus according to any one of claims 5-8, wherein said antenna-moving device includes a moving-state changing portion operable to change a state of movement of said receiver antenna, when said wheel-position-related-data obtaining device fails to obtain said wheel-position related data of at least one of the wheels which
10 corresponds to at least one of said at least two of the transmitter devices.

10 10. A tire-state obtaining apparatus according to claim 8 or 9, wherein said adjusting-state changing portion is operable to change at least one of a speed and a manner of changing a relative position between said receiver antenna and each of said
15 at last two of said transmitter devices.

20 11. A tire-state obtaining apparatus according to any one of claims 1-4, wherein at least one of said at least one receiver device includes a plurality of receiver antennas, and said body-side device includes a receiver-antenna selecting device operable to select one of said plurality of receiver antennas, and a selected-antenna-dependent wheel-position-related-data
25 obtaining portion operable to obtain said wheel-position-related data on the basis of a condition in which the receiver antenna selected by said receiver-antenna selecting device receives said tire information.

30 12. A tire-state obtaining apparatus according to claim 11, wherein said plurality of receiver antenna are provided for said at least two of the transmitter devices, respectively.

35 13. A tire-state obtaining apparatus according to claim 11 or 12, wherein said receiver-antenna selecting device includes a highest-reception-intensity-antenna selecting portion operable to select one of said plurality of receiver antennas which has a

highest intensity of reception of said tire information.

14. A tire-state obtaining apparatus according to any one of claims 1-4, wherein at least one of said at least one receiver
5 device includes a plurality of receiver antennas provided for said at least two of the transmitter devices, respectively, and said body-side device includes a highest-reception-intensity-antenna selecting portion operable to select one of said plurality of receiver antennas which has a highest intensity of reception of
10 said tire information.

15. A tire-state obtaining apparatus according to any one of claims 1-4, wherein at least one of said at least one receiver
15 device includes one receiver antenna which has different positional relationships with the at least two wheels provided with said at least two of said transmitter devices, respectively.

16. A tire-state obtaining apparatus according to any one of claims 1-5 and 7-15, wherein at least one of said at least one
20 receiver device includes a plurality of receiver antennas and a tire-information processing portion operable to process sets of said tire information received by said plurality of receiver antennas, and at least one of said plurality of antennas includes at least one common antenna connected to both of said
25 tire-information processing portion and another processing portion which is operable to process information different from said tire information.

17. A tire-state obtaining apparatus according to any one of
30 claims 1-16, wherein said wheel-position-related-data obtaining device is operable to obtain said wheel-position-related data in a selected one of different operation modes, and includes an operation-mode changing portion which is operable, when said wheel-position-related-data obtaining device fails to obtain said
35 wheel-position-related data for at least one of said wheels in one of said different operation modes, to change said one mode to another mode.

18. A tire-state obtaining apparatus according to claim 17, wherein said operation-mode changing device includes at least one of: a sampling-number changing portion operable to change a
5 number of samples of said tire information to be received by at least one of said at least one receiver device; a threshold changing portion operable to change threshold values used to obtain said wheel-position-related data; a selected-wheel-data obtaining portion operable to obtain said wheel-position-related
10 data for selected at least one of said wheels; an inhibiting portion operable to inhibit said wheel-position-related-data obtaining device from obtaining said wheel-position-related data; an amplifier-gain changing portion operable to change an amplifying gain of an amplifier included in at least one of said at least one
15 receiver device; an antenna adjusting portion operable to adjust at least one receiver antenna included in at least one of said at least one receiver device; a reception-sensitivity changing portion operable to change a reception sensitivity of each of said at least one receiver device; and a filtering-mode changing portion
20 operable to change a mode of operation of a filter included in at least one of said at least one receiver device.

19. A tire-state obtaining apparatus including a plurality of wheel-side devices respectively provided on a plurality of wheels
25 of a vehicle, and a body-side device disposed on a body of the vehicle, said tire-state obtaining apparatus obtaining states of tires of the wheels on the basis of information transmitted from said wheel-side devices, characterized in that:

each of said plurality of wheel-side devices includes (a) a
30 tire-state detecting device operable to detect the state of the tire of the corresponding wheel, and (b) a transmitter device operable to transmit a series of tire information including tire-state data indicative of the state of the tire detected by said tire-state detecting device; and

35 said body-side device includes (c) a receiver device to receive sets of the tire information transmitted from the respective transmitter devices, (d) a communication-environment

detecting device operable to detect an environment of communication between said plurality of wheel-side devices and said body-side device, and (e) a wheel-position-related-data obtaining device operable to obtain wheel-position-related data relating to positions of said wheels, on the basis of said environment of communication detected by said communication-environment detecting device, and on the basis of conditions in which said receiver device receives the sets of tire information transmitted from the respective transmitter devices.

20. A tire-state obtaining apparatus including a plurality of wheel-side devices respectively provided on a plurality of wheels of a vehicle, and a body-side device disposed on a body of the vehicle, said tire-state obtaining apparatus obtaining states of tires of the wheels on the basis of information transmitted from said wheel-side devices, characterized in that:

each of said plurality of wheel-side devices includes (a) a tire-state detecting device operable to detect the state of the tire of the corresponding wheel, and (b) a transmitter device operable to transmit a series of tire information including tire-state data indicative of the state of the tire detected by said tire-state detecting device; and

said body-side device includes (c) a receiver device to receive sets of the tire information transmitted from the respective transmitter devices, (d) a wheel-position-related-data obtaining device operable to obtain wheel-position-related data relating to positions of said wheels, on the basis of conditions in which said receiver device receives sets of the tire information transmitted from the respective transmitter devices, (e) a communication-environment detecting device operable to detect an environment of communication between said plurality of wheel-side devices and said body-side device, and (f) an operation-mode changing portion operable to change a mode of operation of said wheel-position-related-data obtaining device, on the basis of said environment of communication detected by said communication-environment detecting device.

21. A tire-state obtaining apparatus according to claim 19 or 20, wherein said communication-environment detecting device includes a vehicle-attitude detecting portion operable to detect an attitude of the vehicle, and an attitude-dependent communication-environment obtaining portion operable to obtain, as said environment of communication, a variation of an actual positional relationship between said receiver device and said transmitter devices from a nominal relationship therebetween, on the basis of the attitude of the vehicle detected by said vehicle-attitude detecting portion.

22. A tire-state obtaining apparatus according to any one of claims 19-21, wherein said communication-environment detecting device includes a vehicle-environment detecting portion operable to detect an environment of the vehicle.

23. A tire-state obtaining apparatus according to any one of claims 19-22, wherein said operation-mode changing device includes at least one of: an amplifier-gain changing portion operable to change an amplifying gain of an amplifier included in said receiver device; an antenna adjusting portion operable to adjust at least one receiver antenna included said receiver device; a reception-sensitivity changing portion operable to change a reception sensitivity of said receiver device; a filtering-mode changing portion operable to change a mode of operation of a filter included in said receiver device; a threshold changing portion operable to change threshold values used to obtain said wheel-position-related data; a sampling-number changing portion operable to change a number of samples of said tire information to be received by said receiver device; a selected-wheel-data obtaining portion operable to obtain said wheel-position-related data for selected at least one of said wheels; and an inhibiting portion operable to inhibit said wheel-position-related-data obtaining device from obtaining said wheel-position-related data.

24. A tire-state obtaining apparatus including a plurality of

wheel-side devices respectively provided on a plurality of wheels of a vehicle, and a body-side device disposed on a body of the vehicle, said tire-state obtaining apparatus obtaining states of tires of the wheels on the basis of information transmitted from
5 said wheel-side devices, characterized in that:

each of said plurality of wheel-side devices includes (a) a tire-state detecting device operable to detect the state of the tire of the corresponding wheel, and (b) a transmitter device operable to transmit a series of tire information including tire-state data
10 indicative of the state of the tire detected by said tire-state detecting device; and

said body-side device includes (c) a receiver device to receive sets of the tire information transmitted from the respective transmitter devices, (d) a vehicle-running-condition
15 detecting device operable to detect a running condition of the vehicle, and (e) a wheel-position-related-data obtaining device operable to obtain wheel-position-related data relating to positions of said wheels, on the basis of the running condition of the vehicle detected by said vehicle-running-condition detecting
20 device, and on the basis of at least one of said state of the tire detected by said tire-state detecting device and a change of the detected state of the tire.

25. A tire-state obtaining apparatus according to claim 24,
25 wherein said tire information further includes air-pressure data indicative of an air pressure of said tire, and said wheel-position-related-data obtaining device includes an air-pressure-dependent wheel-position-related-data obtaining
portion operable to obtain said wheel-position-related data on the
30 basis of at least one of the air pressure of the tire indicated by said air-pressure data and a change of said air pressure.

26. A tire-state obtaining apparatus according to claim 24 or 25,
wherein said vehicle-running-condition detecting device includes
35 at least one of an accelerating-state detecting portion operable to detect an accelerating state of the vehicle, and a turning-state detecting portion operable to detect a turning state of the vehicle.